The Effectivity of Fermented Mulberry Leaves with Rumen Liquor as Broiler Feed on Final Body Weight, Dry Matter and Crude Fiber Digestibility, and Metabolic Energy

H Has*, VD Yunianto and B Sukamto

Master Degree of Animal Science, Animal and Agriculture Faculty, Diponegoro University, Jl. Prof Sudarto,Tembalang Semarang
***Corresponding author e-mail: dan_has.undip@yahoo.com; HP. +6285241615854**

Abstract. Objective of this research was to know the effect of fermented mulberry leaves by rumen liquorin boiler's diet measured from final body weight, dry matter digestibility, crude fiber digestibility, and metabolic energy. One hundred broiler strain CP 707, broiler concentrate, mulberry leaves and other feed stuffs were administered in Completely Randomized Design with 5 treatments, namely T0 (control), T1 (10% mulberry leaves), T2 (10% fermented mulberry leaves), T3 (20% mulberry leaves) and T4 (20% fermented mulberry leaves) with 4 replications. Result revealed that the increasing use of mulberry leaves had significantly lowered final body weight, dry matter and fiber digestibility, metabolic energy. Fermentation treatment at 10% level could increase dry matter digestibility, crude fiber and metabolic energy than those of unfermented. This study concluded that the increasing mulberry leaves in broiler feed could reduce feed digestibility, and fermentation by rumen liquor could optimize the use of mulberry leaves as broilers feed.

Key words: Mulberry leaves, rumen liquor, broiler, fermentation, digestibility

Abstrak. Penelitian bertujuan untuk mengetahui pengaruh daun murbei yang difermentasi dengan cairan rumen sebagai pakan boiler terhadap bobot badan, kecernaan bahan kering, serat kasar dan energi metabolis. Sebanyak 100 ekor broiler dengan pakan berupa daun murbei, dan bahan pakan lainnya digunakan dalam penelitian dengan rancangan acak lengkap 5 perlakuan yaitu T0 (kontol), T1 (penggunaan 10% daun murbei), T2 (10% daun murbei fermentasi), T3 (20% daun murbei) dan T4 (20% daun murbei fermentasi) serta 4 ulangan. Hasil penelitian adalah peningkatan penggunaan daun murbei berpengaruh nyata menurunkan bobot badan, kecernaan bahan kering, kecernaan serat kasar dan energi metabolis pakan. Perlakuan fermentasi pada taraf 10% dapat meningkatkan kecernaan bahan kering, serat kasar dan energi metabolis. Dari penelitian ini disimpulkan bahwa peningkatan daun murbei dalam pakan broiler dapat menurunkan kecernaan pakan dan fermentasi menggunakan cairan rumen dapat mengoptimalkan penggunaan daun murbei sebagai pakan broiler.

Kata kunci: Daun murbei, cairan rumen, broiler, fermentasi, kecernaan

Introduction

It is inevitable that feed takes 70% of total production cost in intensive poultry farming, therefore feed stuff price is predominant in production cost. Recently researchers have shown an increased interest in finding feed alternative which mostly focus on local feed due to its high availability, according to Indonesian Agriculture and Agroindustry, and reasonable price to cut down the cost. However, the availability is still not properly and optimally utilized (Ahmad and Krisnan, 2009).

Mulberry leaves are local feed with good nutrition of 18-20% crude protein (Syahrir et al., 2009) and high productivity from 25 to 30 tons/ha/year (Singh and Makkar, 2002); accordingly, it is a highly potential poultry feed especially for broiler. Recent research about mulberry leaves mostly refers to its medical function and little does about its function as feed or additive for animal. Mulberry leaves contain high crude fiber and deoxynojirimycin, which in human become active compound for diabetes, but in poultry feed serve as antinutrition to prevent carbohydrate

digestibility; therefore it is limited to use as feed. Debate continues on the best management strategies of optimizing mulberry leaves as poultry feed. Some research reported that fermentation could decrease crude fiber eliminate anti nutrition and improve nutritional quality of feed ingredients (Setya et al., 2007; Ali-Mursyid et al., 2010; Wina et al., 2010).

Fermentation produces enzyme that improves chemical organic compounds (carbohydrates, fats, protein, crude fiber and other organic materials) in both aerobic and anaerobic conditions as a result of microorganism enzyme (Sukaryana et al., 2011; Pius et al., 2012). Fermentation was expected to reduce crude fiber and antinutrition so mulberry leaves digestibility can be maximized as feed for poultry. Rumen liquor is local fermentation agent containing multi microorganism and enzyme that benefits to improve nutritional quality and eliminates antinutrion on feed (Budiansyah et al., 2011; Wardani et al., 2004). Rumen liquor fermentation could reduce the effects of antinutrition in mulberry leaves (Syahrir et al., 2010).

The objective of the study was to figure the effectiveness of mulberry leaves as broiler feed by measuring body weight, metabolic energy, dry mater and crude fiber digestibility of broilers fed either by fermented or non fermented by rumen liquor.

Materials and Methods

This research was conducted in Poultry Laboratory and Animal Feed Laboratory, Faculty of Animal and Agriculture Science, Diponegoro University for 3 months. Experiment comprised two phase; first was mulberry fermentation with rumen liquor, made by mixing fresh rumen liquor from slaughter house with 1% molasses, then put in container and stored in anaerobic incubator (37-41^{0}C) for 1 week. Mulberry leaves dried and grinded to mash form and then fermented by rumen liquor starter (10%/kg dry matter) in anaerobic condition as long 2 weeks, according to Sitorus (2002).

Second phase, 100 ten-day old broilers strain CP 707 with an average body weight ±200 g were randomized in 20 experimental units and subjected to Completely Randomized Design with five treatments and four replications. The treatments were: T0 (basal diet without mulberry leaves); T1 (10% mulberry leaves); T2 (10% fermented mulberry leaves); T3 (20% mulberry leaves); T4 (20% fermented mulberry leaves). Basal diet consisted of corn, pollard, fish meal, PMM, mineral mix, rice brand, soybean meal, unfermented mulberry leaves (UML) and fermented mulberry leaves (FML). Feed formulation was adapted from NRC (1994) and SNI (2006), nutrients of experimental diets are shown in Table1.

Body measurement and feed intake were observed weekly. One bird from each experimental unit was put in individual cage for excreta and endogenous collection by using total collection method on 35 days old. Excreta and endogenous were collected in three days, following the procedure by Setya et al. (2007), then sample was analyzed in laboratory to measure nutrient content and digestibility coefficient using procedure by Scott et al. (1982). The observed variables were final body weight (FBW), dry matter digestibility (DMD), crude fiber digestibility (CFD) and metabolic energy (ME). Data were subject to analysis of variance (anova) and followed by Duncan's New Multiple Range Test (Gaspersz, 1991) for differences among treatments with 5% significant level.

Results and Discussion

Table 2 indicates that fermentation by rumen liquor to mulberry leaves can increase crude protein and gross energy but decrease crude fiber. This result is similar to that of

Septinova et al. (2012) and Wizna et al. (2008) that microorganism fermentation could increase crude protein and digestibility, and decrease crude fiber. Rumen liquor contains multi microorganisms that produce multi enzyme (Budiansyah et al., 2011) which can improve nutrient composition and eliminate antinutrition (Setya et al., 2007; Ali-Mursyid et al., 2010; Wina et al., 2010).

Dietary treatments effect on final body weight, dry matter digestibility, crude fiber digestibility and metabolic energy is presented in Table 3. Final body weight (FBW) was significantly (P<0.05) affected by treatments, thus mulberryin feed lowered final body weight. Data showed 10% mulberry in diet had higher FBW than 20% mulberry leaves but lower than control, however there was no significant difference between UML and FML. Difference occurred because mulberry leaves treatments had lower digestibility than control (Table 3).

Table 1. Composition and nutrients content of treatment diets

Ingredients	Treatment Diets				
	T0	T1	T2	T3	T4
	----------% dry matter----------				
Corn	55	51	51	48	48
Rice bran	6	5	5	3	3
Soybean meal	14	13	13	10	10
Pollard	10	6	6	4	4
Fish meal	12	12	12	12	12
PMM	2	2	2	2	2
Plant oil	1	1	1	1	1
Mulberry leaf	0	10	10	20	20
Total	100	100	100	100	100
Nutrients					
Crude Protein(%)	22.01	22.02	22.22	22.01	22.43
Crude fat (%)	4.19	4.17	4.17	4.07	4.07
Crude fiber (%)	5.6	7.2	6.8	8.9	8.1
ME (Kcal/kg)	2930	2909	2908	2926	2922
Lysine (%)	1	1.1	1.18	1.1	1.2
Methionine(%)	0.42	0.44	0.48	0.46	0.5

Table 2. Nutrient content of fermented and unfermented mulberry leaves

Nutrients	Unfermented Mulberry	Fermented Mulberry
Crude Fiber (%)	25	23
Crude Protein (%)	20	23
Gross Energy (kcal/kg)	3896.98	3922.36

Analysis of Animal Feed and Biochemical Laboratory, Faculty of Animal and Agriculture Science Diponegoro University

Table 3. Final body weight, dry matter digestibility, crude fiber digestibility and metabolic energy of diet treatments

Parameters	Treatment Diets				
	T0	T1	T2	T3	T4
Final body weight (g)	1335±68^{a}	1266.8±22^{b}	1204.6±21^{b}	1060.6±34^{c}	1075.2±35^{c}
Dry matter digestibility(%)	61.30±2.1^{a}	48.38±1.9^{c}	51.91±1.9^{b}	45.60±2.1^{c}	48.37±0.9^{c}
Crude fiber digestibility(%)	47.25±5.2^{a}	33.66±6.5^{b}	45.30±7.3^{a}	16.78±6.9^{c}	17.70±3.5^{c}
Metabolic energy (kcal/kg)	3227.2±90.9^{a}	2779.7±103.6^{c}	3065.9±75.9^{b}	2590.6±111^{d}	2635.2±74.6^{d}

Values bearing different superscript within rows show significant difference (P<0.05).
T0 (without mulberry leaves), T1 (10% UML), T2 (10% FML), T3 (20% UML), T4 (20% FML).

Dry matter digestibility (DMD) of mulberry treatments (10% and 20%) was significantly lower (P<0.05) than that of control, namely T2 was higher than T1, T3 and T4. DMD of 10% fermented mulberry leaves (FML)was higher (P<0.05) than 10% unfermented mulberry leaves (UML), however 20% FML was not significantly different from 20% UML but its DMD value was higher than others. This difference was due to effect of increasing total crude fiber on diet mulberry leaf; accordingly total fiber in diet T0 was lower than that of other treatments (Table 1). Ironkwe and Oruwari (2012) found that high crude fiber caused an increasing digestion rate in the gastrointestinal tract and therefore reducing digestion time and nutrients absorption by gastrointestinal membrane. Jiménez et al. (2013) also reported that increasing total fiber in diet significantly affected nutrients retention (dry matter, organic matter and nitrogen).

Digestibility of Mulberry leaves can be enhanced with rumen liquor fermentation. Syahrir et al. (2010), reported that the fermented mulberry leaves extract had better digestibility characterized by a higher body weight in mice experiment than non-fermented mulberry leaves extract. Microorganism fermentation could improve digestibility in poultry digestive tract (Sukaryana et al., 2011; Setya et al., 2007).

Crude fiber digestibility (CFD) was significantly (P<0.05) affected by diet treatments. Ten percent FML is not different from T0 but significantly higher than T1, T3 and T4. Ten percent UML was higher than T3 and T4 but lower than 10% FML and control. Fermentation with rumen liquor revealed better CFD in 10% mulberry leaves level. Alu et al. (2012) reported that crude fiber digestibility of broiler chickens fed with high fiber such as ground nut shells ranged from 45-55%. Onimisi (2008), reported digestibility of crude fiber broilers fed low fiber (2%) ranged from 62.4% - 74.5%.

Mulberry leaves in diet made total crude fiber higher than that of control and lowered nutrient digestibility. Ezieshi and Olomu (2004) reported that palm kernel cake and maize offal resulted differently in nutrient retention, which may be related to the differences in the crude fiber contents of the diets. Higher crude fiber content of the diets may have adversely affected digestion. Same result also reported by Sumiati et al. (2011) that increasing total crude fiber and antinutrition in diet directly affected broiler performance.

Mangisah et al. (2006) reported that microorganism fermentation changed fiber quality and had better digestibility in right level. Fermentation could increase CFD in 10% FML, change fiber composition in mulberry leaves and maximize the use in diet, but 20% FML was not different from 20% UML. This was because total crude fiber in mulberry leaves treatments had surpassed broiler crude fiber tolerant, therefore no fermentation effect occured. Maximum crude fiber in broiler diet in Indonesia was 6% (SNI, 2006), while total crude fiber in mulberry leaves treatments passed that standard (Table 1).

Table 3 shows that metabolic energy was significantly (P<0.05) affected by treatments. Control is higher than other treatments, in that metabolic energy in 10% FML was higher (P<0.05) than that in 10% UML, 20% UML and 20% FML. Metabolic energy in 10% UML was higher than that in 20% UML and 20% FML but lower than control and 10% FML. Increasing mulberry percentage in diet composition decreased metabolic energy, but fermentation with rumen liquor positively increased metabolic energy. Based on NRC (1994) and SNI (2006), standard broiler metabolic energy required was 2900-3200 kcal; accordingly, diets T0 and T2 still met the standard while T1, T3 and T4 did not.

Metabolic energy (ME) decline was in line with increasing percentage of mulberry leaves in diet (Figure 1). Ani et al. (2012) reported that

the use of forage-based feed ingredients affected the increasing in total diet crude fiber which has an impact on energy utilization, anti nutritional also affect the digestibility and nutrient retention. Local feed that have different amount crude fiber also have different metabolic energy, the higher crude fiber the lower metabolic energy (Bahri and Rusdi, 2008).

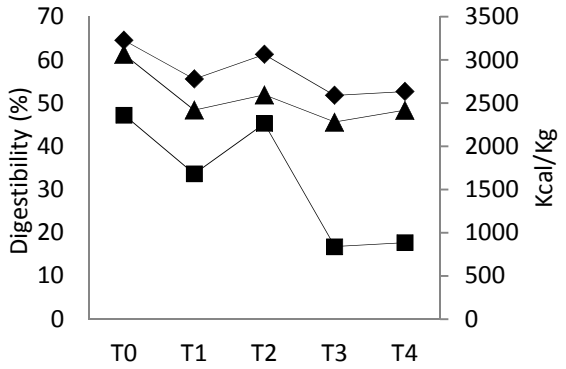

Figure 1. Nutrients digestibility of diet using mulberry leaves (▲dry matter digestibility, ■crude fiber digestibility, ♦metabolic energy).
T0 (control); T1(10%UML); T2(10%FML); T3(20%UML); T4(20FML)

Increasing fiber level in diet reduced feed digestibility in the digestive tract. Saki et al. (2011) reported that the right combination of pectin and cellulose (fiber) could increase the performance of broilers, but excess resulted in lower digestibility and decreased performance. Siri et al. (1992) elevated levels of ADF and NDF in feed and obtained digestibility reduction of the energy and dry matter.

10% FML treatment had higher ($P<0.05$) ME than 10% UML, while 20% FML was not significantly different from 20% UML but higher than others. This results showed that rumen liquor fermentation could increase metabolic energy of broiler. Ramli et al. (2005) and Zou et al. (2013) shared common result that microorganism fermentation could increase metabolic energy.

Mulberry antinutrition called 1-deoxy nojirimycin (DNJ) could affect energy source absorbtion by preventing polysacaride hidrolysis and decreasing metabolic energy. Oku et al. (2006) and Yatsunami et al. (2011) reported that DNJ from mulberry could block α glycosidase activity which hydrolyzes polysaccharide into plain molecule. This study showed that effect of mulberry antinutrition could be minimized by rumen liquor fermentation. Wardani et al. (2004) reported combination between rumen enzyme and steam could increase metabolic energy by elevating digestibility and eliminating antinutrition.

Conclusion

The results of this study showed a decline in final body weight and digestibility of nutrients as long the increased use of mulberry leaves in broiler'sfeed, but rumen liquorfermentation treatments proven an improving digestibility of mulberry leavesthan unfermented treatments.

Acknowledgement

This study presented in this paper was conducted during postgraduate study in Magister of Animal Science Diponegoro University with financial support by Excellence Scholarship from Directorate General of Higher Education, and the Ministry of National Education of Indonesia.

References

Ahmad H and R Krisnan. 2009. Sumber dan Ketersediaan Bahan Baku Pakan di Indonesia. IPB Press, Bogor.

Ali-Mursyid W, MZ Bachruddin, Zuprizal and MN Cahyanto. 2010. Corn substitution using fermented solid cassava waste on broiler chicken. J. Indon. Trop. Anim. Agric. 35(1):9-15.

Alu SE, MM Adua, HI Damulak, RS Umar, AD Abubakarand and UD Matthew. 2012. Growth rate and nutrient digestibility by broilers fed alkali-treated birds groundnut (*Arachis hypogea*)

shell meal-based diets. Scholarly J. Agric. Sci. 2(10):231-237.

Ani AO, OD Omeje and LC Ugwuowo. 2012. Effects of raw bambara nut (*Voandzeia subterranea* l) waste and enzyme complex on growth performance and apparent nutrient retention in broiler chickens. African J. Biotech. 11(56): 11991-11997.

Bahri S and Rusdi. 2008. Energi metabolis pakan lokal pada ayam petelur. J. Agroland. 15(1):75–78.

Budiansyah A, Nahrowi, KG Wiryawan, MT Suhartono and Y Widyastuti. 2011. Effect of Sediment from Cattle Rumen Liquor as Feed Supplement on Broiler Performance. In: Proceeding of National Seminar on Animal Farming and Veterinary Technology. Pp:641-650 (in Indonesian with abstract in English)

Ezieshi EV and JM Olomu. 2004. Comparative performance of broiler chickens fed varying levels of palm kernel cake and maize offal. Pakistan J. Nut. 3(4):254-257.

Gaspersz V. 1991. Metode Rancangan Percobaan. Armico, Bandung.

Singh B and HPS Makkar. 2002. The Potential of Mulberry Foliage as A Feed Supplement in India. In: Proceedings of Mulberry for Animal Production FAO Animal Production and Health Paper 147. Rome, May and August, 2002. Sánchez MD Editor. Pp:139-156.

Ironkwe MO and BM Oruwari. 2012. Effect of replacement levels of maize with plantain peel in broiler finisher diets. Bulletin of Environment Pharmacology and Life Sci. 1(4):39-42.

Jiménez EM, M Frikha, A de Coca Sinova, J García and GG Mateos. 2013. Oat hulls and sugar beet pulp in diets for broilers; Effects on growth performance and nutrient digestibility. Anim. Feed Sci. Tech. 182:33– 43.

Mangisah I, Tristiarti, W Murningsih, MH Nasoetion, ES Jayanti and Y Astuti. 2006. Kecernaan nutrien eceng gondok yang difermentasi dengan Aspergilus niger pada ayam broiler J. Indon. Trop. Anim. Agric. 31(2):124-128.

NRC (National Research Council). 1994. Nutrient Requirements of Poultry: 9th Revised. National Academy of Sciences, Washington DC.

Oku T, M Yamada, M Nakamura, N Sadamori and S Nakamura. 2006. Inhibitory effects of extractives from leaves of Morus alba on humanand rat small intestinal disaccaridase activity. Brit. J. Nutri. 95(5):933-938.

Onimisi PA, II Dafwang, JJ Omage and JE Onyibe. 2008. Apparent digestibility of feed nutrients, total tract and ileal amino acids of broiler chicken fed quality protein maize (Obatampa) and normal maize. Int. J. Poult. Sci. 7(10):959-963.

Pius PK, T Purwadaria, AP Sinurat and T Haryati. 2012. Effect of fiber hydrolytic enzymes supplementation on performances of broiler chickens fed diets containing rice bran. JITV 17(3):229-233.

Saki AA, Hemati Matin, P Zamani and F Mirzaaghatabar. 2011. Nonstarch polysaccharides and broiler responses. World App. Sci. J. 15(2):192-198

Scott ML, MC Nesheim and RI Young, 1982. Nutrition of The Chicken. 2nd ed. M.L. Scott and Assosiation. Itacha, New York.

Septinova D, T Kurtini and S Tantalo. 2012. Evaluation the usage of treated shrimp waste as protein source in broiler diet. Anim. Prod. 12(1):1-5.

Setya CU, I Estiningdriati, VD Yunianto and W Murningsih. 2007. Pengaruh penambahan aras mineral pada fermentasi sorghum dengan ragi tempe terhadap kecernaan nutrien pada ayam petelur. Anim. Prod. 9(1):14-17.

Siri S, H Tobioka and I Tasaki. 1992. Effect of dietary cellulose level on nutrient utilization in chickens. Asian Austral. J. Anim. Sci. 5(4):741-746.

Sitorus TF. 2002. Peningkatan Nutrisi Kualitas Jerami Padi Yang Difermentasi Ragi Isi Rumen. Thesis. Magister Ilmu Ternak Fakultas Peternakan Universitas Diponegoro. Semarang.

SNI (Standar Nasional Indonesia). 2006. Pakan Ayam Ras Pedaging Fase Akhir (Broiler Finisher). Badan Standarisasi Nasional. Jakarta.

Sukaryana Y, U Atmomarsono, V D Yunianto and E Supriyatna. 2011. Peningkatan nilai kecernaan protein kasar dan lemak kasar produk fermentasi campuran bungkil inti sawit dan dedak padi pada broiler. J. Anim. Sci. Tech. 1(3):167-172.

Sumiati, Farhanuddin, W Hermana, A Sudarman, N Istichomah and A Setiyono. 2011. Performa ayam broiler yang diberi ransum mengandung bungkil biji jarak pagar (Jatropha curcas L.) hasil fermentasi menggunakan Rhizopus oligosporus. Media Peternakan. 34(2):117-125.

Syahrir S, KG Wiryawan and A Parakkasi. 2009. Efektivitas daun murbei sebagai pengganti konsentrat dalam sistem rumen in vitro. Media Peternakan. 32(2):112-119.

Syahrir S, KG Wiryawan, A Parakkasi, Winugroho and C Lini. 2010. Efek ekstrak daun murbei terfermentasi sebagai komponen pakan terhadap performa mencit. Indon. Anim. Sci. 5(2):81–86.

Wardani WW, N Ramli and W Hermana. 2004. Ketersediaan energi ransum yang mengandung wheat pollard hasil olahan enzim cairan rumenyang diproses secara steam pelleting pada ayam broiler. Media Peternakan. 27(3):123-128.

Wina E, B Tangendjaja, T Pasaribu and T Purwadaria. 2010. Performans ayam pedaging yang diberi bungkil biji jarak (Jatropha curcas) didetoksifikasi dengan perlakuan fermentasi, fisik dan kimia. JITV 15(3):174-181.

Wizna, H Abbas, Y Rizal, A Dharma and IP Kompiang. 2008. Improving the qualityof sago pith and rumen content mixtureas poultry feed through fermentation by Bacillus amyloliquefaciens. Pakistan J. Nutri. 7:249-254.

Yatsunami K, K Murata and T Kamei. 2011. I-Deoxynojirimycin content and alfa-glucosidase inhibitory activity and heat stability of 1-deoxynojirimycin in silkworm powder. Food and Nut. Sci. 2:87-89.

Zou J, P Zheng, K Zhang, X Ding and S Bai. 2013. Effects of exogenous enzymes and dietary energyon performance and digestive physiology of broilers. J. Anim. Sci. Biotech. 4(14):1-9.